

Name: Key
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Section A - Problem Solving - SHOW YOUR WORK!

1. What is the momentum of Jeff Gordon's Car if it has a mass of 1600 kg and is traveling 80 m/s West?

Data

$m = 1600 \text{ kg}$
 $v = 80 \text{ m/s West}$
 $p = ?$

eq

$p = m v$

sub

$p = (1600 \text{ kg})(80 \text{ m/sW})$

$p = 128,000 \text{ kg m/s West}$

 answer units/dir

Rubric:

- ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

2. How fast is a 75 kg runner going, if she has a momentum of 185 kg-m/s South?

Data

$m = 75 \text{ kg}$
 $p = 185 \text{ kg m/s S}$
 $v = ?$

eq
 $p = m v$

sub

$185 \text{ kg m/s S} = (75 \text{ kg})(v)$

$v = \frac{185 \text{ kg m/s S}}{75 \text{ kg}} =$

$v = 2.47 \text{ m/s S}$

Answer UNITS/DIR.

Rubric:

- ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

3. What is the velocity of a .004 kg bullet, if has a momentum of 3.86 kg-m/s West?

Data

$m = .004 \text{ kg}$
 $p = 3.86 \text{ kg m/s W}$
 $v = ?$

eq

$p = m v$

sub

$3.86 \text{ kg m/s W} = (.004 \text{ kg})(v)$

$v = \frac{3.86 \text{ kg m/s W}}{.004 \text{ kg}} =$

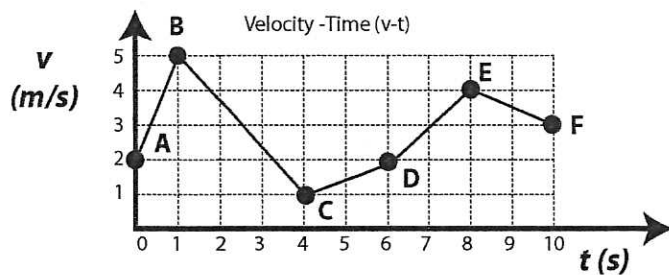
$v = 965 \text{ m/s West}$

ans units/dir

Rubric:

- ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

4. What is the momentum of a skier, if her mass is 70 kg in the various points in the v-t graph below?



Rubric:
 ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

A) $m = 70 \text{ kg}$
 $v_A = 2 \text{ m/s South}$ } Data
 $p_A = ?$
 $p_A = m v_A$ eq
 $p_A = (70 \text{ kg})(2 \text{ m/s South})$ sub
 $p_A = 140 \text{ kg m/s South}$ ans/units/dir

B) $m = 70 \text{ kg}$
 $v_B = 5 \text{ m/s South}$ } Data
 $p_B = ?$
 $p_B = m v_B$ eq
 $p_B = (70 \text{ kg})(5 \text{ m/s South})$ sub
 $p_B = 350 \text{ kg m/s South}$ ans/units/dir

C) $m = 70 \text{ kg}$
 $v_C = 1 \text{ m/s South}$ } data
 $p_C = ?$
 $p_C = m v_C$ eq
 $p_C = (70 \text{ kg})(1 \text{ m/s South})$ sub
 $p_C = 70 \text{ kg m/s South}$ ans/units/dir

D) $m = 70 \text{ kg}$
 $v_D = 2 \text{ m/s South}$ } data
 $p_D = ?$
 $p_D = m v_D$ eq
 $p_D = (70 \text{ kg})(2 \text{ m/s South})$ sub
 $p_D = 140 \text{ kg m/s South}$ ans/units/dir

E) $m = 70 \text{ kg}$
 $v_E = 4 \text{ m/s South}$ } data
 $p_E = ?$
 $p_E = m v_E$ eq
 $p_E = (70 \text{ kg})(4 \text{ m/s South})$ sub
 $p_E = 280 \text{ kg m/s South}$ ans/units/dir

F) $m = 70 \text{ kg}$
 $v_F = 3 \text{ m/s South}$ } data
 $p_F = ?$
 $p_F = m v_F$ eq
 $p_F = (70 \text{ kg})(3 \text{ m/s South})$ sub
 $p_F = 210 \text{ kg m/s South}$ ans/units/dir

5. What is the momentum of an 8 kg bowling ball if it has a velocity of 2 m/s West?

data $\begin{cases} m = 8 \text{ kg} \\ v = 2 \text{ m/s W} \\ p = ? \end{cases}$ $\xrightarrow{\text{eq}} p = mv$ $\xrightarrow{\text{sub}} p = (8 \text{ kg})(2 \text{ m/s W})$

$p = 16 \text{ kg m/s West}$

ans units/dir

Rubric:
 ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

6. How fast is a 55 kg runner going if she has a momentum of 185 kg-m/s South?

DATA $\begin{cases} m = 55 \text{ kg} \\ p = 185 \text{ kg m/s South} \\ v = ? \end{cases}$ $\xrightarrow{\text{eq}} p = mv$ $\xrightarrow{\text{sub}} (185 \text{ kg m/s S}) = (55 \text{ kg}) v$

$v = \frac{185 \text{ kg m/s S}}{55 \text{ kg}}$

$v = 3.36 \text{ m/s South}$

Rubric:
 ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

7. How fast would a 100 kg running back have to run to have the same momentum as a 160 kg linebacker running at 5 m/s West?

Data $\begin{cases} m_{RB} = 100 \text{ kg} \\ v_{RB} = ? \\ m_{LB} = 160 \text{ kg} \\ v_{LB} = 5 \text{ m/s W} \end{cases}$ $\xrightarrow{\text{equations}} p_{RB} = p_{LB}$

$(m_{RB})(v_{RB}) = (m_{LB})(v_{LB})$

$(100 \text{ kg})(v_{RB}) = (160 \text{ kg})(5 \text{ m/s W}) \xrightarrow{\text{sub}}$

$v_{RB} = \frac{(160 \text{ kg})(5 \text{ m/s W})}{100 \text{ kg}} = 8 \text{ m/s W}$ ans / units/dir

Rubric:
 ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

8. A 80 kg male ice skater and a 60 kg female skater must have the same momentum as they approach each other to end their routine. If the female's approach speed is 10 m/s East, what must the male's speed be?

Data $\begin{cases} m_m = 80 \text{ kg} \\ v_m = ? \\ m_f = 60 \text{ kg} \\ v_f = 10 \text{ m/s E} \end{cases}$ $\xrightarrow{\text{equations}} p_m = p_f$

$(m_m)(v_m) = (m_f)(v_f)$ $\xrightarrow{\text{sub}}$

$(80 \text{ kg})(v_m) = (60 \text{ kg})(10 \text{ m/s E})$

$v_m = \frac{(60 \text{ kg})(10 \text{ m/s E})}{80 \text{ kg}}$

Answer / units/dir $7.5 \text{ m/s W} = v_m$

Rubric:
 ___ Data
 ___ Equation
 ___ Substitution
 ___ Answer
 ___ Units/Direction

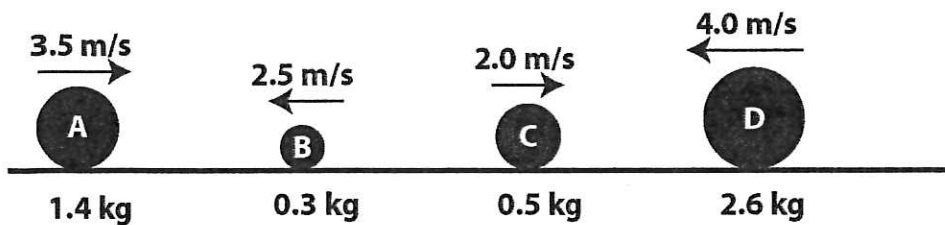
9. Rank the following vehicles from the lowest momentum to the highest momentum if their speed is the same

	relative mass	$m =$	$p =$	
A) A Harley Davidson Motorcycle	2	*	1	A
B) A Motobecane Mountain Bicycle	1	*	1	B
C) A full School Bus	4	*	1	C
D) A Hummer H3 SUV	3	*	1	D
E) A full Tractor Trailer	5	*	1	E

B A D C E

Lowest Highest

10. Four balls are rolling as shown in Figure 4.1. Calculate each ball's momentum.



Rubric:

___ Data
___ Equation
___ Substitution
___ Answer
___ Units/Direction

<p>A) $v_A = 3.5 \text{ m/s R}$ $m_A = 1.4 \text{ kg}$ $p_A = ?$ $p_A = m_A v_A$ $p_A = (1.4 \text{ kg})(3.5 \text{ m/s R})$ $p_A = 4.9 \text{ kg m/s Right}$</p>	<p>B) $v_B = 2.5 \text{ m/s Left}$ $m_B = 0.3 \text{ kg}$ $p_B = ?$ $p_B = m_B v_B$ $p_B = (0.3 \text{ kg})(2.5 \text{ m/s Left})$ $p_B = 0.75 \text{ kg m/s Left}$</p>
<p>C) $v_C = 2.0 \text{ m/s R}$ $m_C = 0.5 \text{ kg}$ $p_C = ?$ $p_C = m_C v_C$ $p_C = (0.5 \text{ kg})(2.0 \text{ m/s R})$ $p_C = 1 \text{ kg m/s R}$</p>	<p>D) $v_D = 4 \text{ m/s L}$ $m_D = 2.6 \text{ kg}$ $p_D = ?$ $p_D = m_D v_D$ $p_D = (2.6 \text{ kg})(4 \text{ m/s L})$ $p_D = 10.4 \text{ kg m/s L}$</p>

11. A lunar vehicle is tested on Earth at a speed of 10 km/h West. When it's sent to the moon and travels at the same speed, will it's momentum be the same, greater or less than that on Earth? Explain.

THE LUNAR VEHICLE WILL HAVE THE SAME SPEED AS THAT ON EARTH. IF IT GOES FAST ENOUGH, IT WOULD EXPERIENCE LESS DRAG ON THE MOON BECAUSE THE MOON'S ATMOSPHERE IS LESS DENSE.

Rubric:

___ Data
___ Equation
___ Substitution
___ Answer
___ Units/Direction

12. How fast would a 1000 kg Smart Car have to move to have the same momentum as a 3100 kg Ford F150 pick-up moving at 8 km/h (~5 mph) North?

data

$$\begin{aligned}
 m_{SC} &= 1000 \text{ kg} \\
 v_{SC} &= ? \\
 m_T &= 3100 \text{ kg} \\
 v_T &= 8 \text{ km/h North}
 \end{aligned}$$

eq

$$p_{SC} = p_T$$

$$m_{SC} v_{SC} = m_T v_T$$

sub

$$(1000 \text{ kg})(v_{SC}) = (3100 \text{ kg})(8 \text{ km/h N})$$

$$v_{SC} = \frac{(3100 \text{ kg})(8 \text{ km/h N})}{1000 \text{ kg}}$$

$$v_{SC} = 24.8 \text{ km/h N}$$

ans units dir

Rubric:

___ Data
___ Equation
___ Substitution
___ Answer
___ Units/Direction